

from the northwest, a slight haziness, and a few small whitish cumulus clouds. There were hardly any noticeable changes throughout the day in these conditions. Compared with a series of observations made a few days previous (July 17th) the curve for the monument is remarkably quiet and even. On the date mentioned, the sky being cloudless and hazy, the wind from the sw., and no indication of rain, the values obtained exceeded at times 3,000 volts in a positive direction and averaged for the whole forenoon half this value, the needle oscillating almost continually. In the afternoon the indications were more steady and even, the values ranging under 1,000 volts. July 20th was a date on which no especial electrical activity might have been expected, and the curves in their general character show about as close a correspondence as might be looked for.

The third diagram represents the results of observations made during the passage of a thunder-storm at Ithaca, New York (the physical laboratory of Cornell University). The exposure at this place is such that in fair weather the average indications exceed 600 volts, while in stormy weather changes of more than 2,000 volts occur. On June 25th, in the early part of the forenoon, light showers occurred to the s. and sw. of the place of observation. The indications were steadily negative. At 5.30 p. m. dark cumulus clouds came up from the nw., wind light, and distant thunder audible. Here, as elsewhere, was noticed the sudden movement of the needle simultaneous with the flash of lightning. Rain commenced at 6.07 p. m.; heavy rain in a few minutes. The following abbreviated table is from the observer's notes:

June 25, 1886:	
6.05 00 p. m., thunder.	6.24 45 p. m., sudden increase in rain.
6.06 14 p. m., lightning.	6.27 10 p. m., lightning.
15 p. m., thunder.	6.27 15 p. m., thunder.
6.07 20 p. m., lightning.	6.28 15 p. m., lightning.
6.08 00 p. m., thunder.	6.28 35 p. m., thunder.
6.08 20 p. m., lightning.	6.29 00 p. m., lightning.
6.09 00 p. m., heavy rain; torrents.	6.30 50 p. m., lightning.
6.10 15 p. m., lightning.	6.31 30 p. m., lightning; distant thunder.
6.10 20 p. m., thunder.	6.32 20 p. m., lightning.
6.11 50 p. m., lightning.	6.00 45 p. m., lightning.
6.12 35 p. m., lightning.	6.33 00 p. m., thunder.
6.13 00 p. m., thunder.	6.33 35 p. m., a clinking sound heard in electrometer, probably sparking.
6.13 10 p. m., lightning.	6.34 05 p. m., ditto.
6.13 55 p. m., thunder.	6.35 00 p. m., needle not oscillating.
6.14 10 p. m., lightning.	6.36 00 p. m., lightning.
6.14 50 p. m., lightning.	6.36 05 p. m., thunder.
6.15 30 p. m., lightning.	6.36 30 p. m., rain diminishing.
6.15 55 p. m., lightning.	6.38 20 p. m., lightning; clinking in electrometer.
6.16 15 p. m., thunder.	6.39 10 p. m., thunder distant.
6.16 35 p. m., lightning.	6.40 00 p. m., needle steady.
6.17 00 p. m., lightning.	6.41 00 p. m., light rain.
6.17 05 p. m., thunder.	6.42 00 p. m., storm past, but a dark cloud arising in southwest.
6.17 35 p. m., lightning.	6.43 00 p. m., distant thunder.
6.17 45 p. m., thunder.	6.43 20 p. m., lightning; distant thunder.
6.18 10 p. m., lightning.	6.43 40 p. m., distant thunder.
6.18 25 p. m., thunder.	6.46 00 p. m., clearing up in west.
6.18 56 p. m., lightning.	6.47 00 p. m., dark cloud, sw., 2 miles; storm now in e.
6.19 07 p. m., thunder.	6.48 00 p. m., thunder very distant.
6.19 25 p. m., lightning.	6.48 20 p. m., lightning.
6.19 45 p. m., lightning.	6.48 40 p. m., thunder.
6.20 00 p. m., thunder.	6.49 00 p. m., rain ended.
6.20 37 p. m., lightning.	6.50 00 p. m., dark cloud in ssw.
6.20 50 p. m., thunder.	6.52 40 p. m., lightning.
6.21 00 p. m., thunder.	6.52 50 p. m., thunder; raining in ssw.
6.21 40 p. m., lightning.	7.00 00 p. m., distant thunder.
6.22 14 p. m., lightning.	7.02 30 p. m., distant thunder.
6.22 35 p. m., lightning.	7.17 00 p. m., last thunder heard.
6.22 50 p. m., thunder.	7.20 00 p. m., very light rain and rain-bow.
6.23 00 p. m., lightning.	
6.23 09 p. m., thunder.	
6.23 20 p. m., lightning.	
6.23 40 p. m., thunder.	
6.24 10 p. m., lightning.	
6.24 20 p. m., thunder.	

*Observations at the summit of the Washington Monument (elevation 500 feet) during a thunder-storm.*

July 14th, 1886, in the early part of the afternoon a thunder squall came up suddenly; at 2.45 p. m. the sky was covered

with a pallium of stratus clouds, and distant thundering was audible; darker cumulus clouds came rapidly from the west, and by 3.15 p. m. the storm was overhead; two very vivid lightning flashes, with sharp and loud thunder, occurred about this time; at 3.40 p. m. the storm had passed. The collector was exposed from window on the south side, the height above the ground being about five hundred and five feet. When connected with the collector the needle was greatly excited, moving from one side to the other rapidly. The greatest deflection noticed showed a negative potential equivalent to about 3,000 volts. Sparks, however, were constantly passing between the wire-suspending fibre and the neck of the brass top-plate of the electrometer. In addition to the rapid oscillatory movements of the needle there was an up-and-down-jumping disturbance. As it was impossible to do anything with electrometer as then arranged, the wire connecting it with the collector was removed and a wire connected with the ground, held about  $\frac{1}{2}$  inch away from the side of the collector. Sparks passed continuously at a rate of about 10 to 15 per second. By measurement the length of the spark was  $\frac{5}{8}$  inch. There were two intense lightning flashes about 3.10 p. m. seemingly in close proximity to the monument. Simultaneously with the lightning the following phenomena were noticed: 1st, An alteration in the character of the stream of water issuing from the nozzle of the collector. Previous to the flash, and apparently depending upon the degree of electrification, the stream would be twisted and split into many fine threads and sprays; but instantly, with the occurrence of the flash, the stream resumed its normal character, maintaining it for a few seconds and then gradually becoming more and more distorted until the occurrence of another flash, when the same state of things was repeated. 2d, There was noticed a cessation of the sparking between the collector and the ground wire, simultaneously with the flash. Then long before thunder was heard (in one case eight seconds) the sparking would again begin and increase rapidly. At 3.40 p. m. the storm appeared to be over, and at this time the electrometer indications were positive and much more constant.

## OPTICAL PHENOMENA.

### SOLAR HALOS.

Solar halos were observed in the various states and territories during the month, as follows:

*Alabama.*—Mobile, 26th.  
*Arizona.*—Yuma, 3d; Prescott, 10th.  
*Arkansas.*—Lead Hill, 3d.  
*Colorado.*—Montrose, 20th, 29th.  
*Connecticut.*—New Haven, 1st.  
*Dakota.*—Webster, 19th; Fort Buford, 25th, 29th.  
*District of Columbia.*—Washington City, 21st.  
*Florida.*—Key West, 10th, 12th, 23d; Archer, 10th, 15th, 21st, 29th.  
*Georgia.*—Atlanta, 2d.  
*Idaho.*—Boisé City, 13th.  
*Illinois.*—Cairo, 6th; Riley, 8th, 10th, 19th; Springfield, 19th; Chicago, 28th; Pekin, 30th.  
*Indiana.*—Jeffersonville, 6th; Vevay, 12th, 19th, 25th; Indianapolis, 15th; Greencastle, 16th.  
*Iowa.*—Cedar Rapids, 2d, 5th; Keokuk and Davenport, 19th; Corydon, 27th.  
*Kansas.*—Wakefield, 3d.  
*Kentucky.*—Frankfort, 6th.  
*Maine.*—Portland, 9th, 14th, 22d; Cornish, 9th, 22d.  
*Maryland.*—Baltimore, 20th, 21st.  
*Massachusetts.*—Amherst, 1st; Blue Hill Observatory, 1st, 11th, 22d.  
*Michigan.*—Escanaba, 6th; Grand Haven, 7th.  
*Minnesota.*—Saint Vincent, 24th.  
*Missouri.*—Saint Louis, 3d.  
*Montana.*—Poplar River, 7th.  
*Nebraska.*—Valentine, 10th; De Soto, 26th.

*New Jersey*.—Egg Harbor City, 20th; Atlantic City, 21st; Dover, 21st, 27th.

*New York*.—Albany, 1st, 11th; Oswego, 9th, 11th, 20th; Palermo, 9th, 11th, 22d; Ithaca, 11th; Buffalo, 14th, 15th, 20th; Mountainville and Syracuse, 20th.

*North Carolina*.—Fort Macon, 5th, 23d; Kitty Hawk and Weldon, 21st; Smithville and Wilmington, 23d.

*Ohio*.—Wauseon, 4th, 5th, 8th, 19th to 23d, 27th, 28th; Garrettsville, 20th; Toledo, Westerville, and Tiffin, 27th.

*Oregon*.—Roseburg, 9th; East Portland, 19th.

*Pennsylvania*.—East Brook, 3d, 11th, 20th, 21st, 25th, 27th; Philadelphia, 9th, 21st; Pittsburg, 21st; Erie, 27th.

*South Carolina*.—Stateburg, 7th, 20th, 23d, 27th, 28th.

*Tennessee*.—Nashville, 1st, 5th, 9th, 12th, 19th, 21st, 27th; Chattanooga, 1st, 30th.

*Texas*.—Fort Stockton, 11th.

*Vermont*.—Strafford, 9th, 11th, 22d.

*Virginia*.—Lynchburg, 2d, 20th; Fort Myer, 4th, 6th, 21st; Variety Mills, 6th, 13th, 21st; Dale Enterprise, 4th, 19th, 21st, 29th; Cape Henry, 21st.

*Washington Territory*.—Port Angeles, 5th, 23d, 25th; Walla Walla, 9th, 18th; Tatoosh Island, 23d.

*Wyoming*.—Fort Bridger, 20th, 24th, 30th.

#### LUNAR HALOS.

Lunar halos were observed in the various states and territories during the month, as follows:

*Alabama*.—Birmingham, 10th; Mobile, 12th, 13th.

*Arkansas*.—Fort Smith, 6th, 16th.

*California*.—Salinas, 8th; Fort Bridger, 20th.

*Colorado*.—Pike's Peak, 17th.

*Connecticut*.—New London, 21st.

*District of Columbia*.—Washington City, 11th, 13th.

*Florida*.—Sanford, 7th, 14th; Cedar Keys, 10th, 14th, 16th; Archer, 14th; Jacksonville, 14th, 15th; Key West, 17th.

*Georgia*.—Atlanta, 10th; Augusta, 15th.

*Illinois*.—Cairo, 6th, 9th; Windsor, 7th, 12th; Pekin, 7th, 18th; Sycamore, 10th; Riley, 10th, 12th; Springfield, 12th.

*Indiana*.—Jeffersonville, 9th, 12th; Greencastle, Indianapolis, and Terre Haute, 12th.

*Indian Territory*.—Fort Sill, 16th.

*Iowa*.—Des Moines, 12th.

*Kansas*.—Sterling and El Dorado, 15th.

*Kentucky*.—Frankfort, 7th, 8th, 9th, 12th; Louisville, 10th.

*Louisiana*.—New Orleans, 12th, 13th; Grand Coteau, 18th.

*Maine*.—Orono, 12th.

*Massachusetts*.—Amherst, 20th; Boston, 22d.

*Michigan*.—Grand Haven, 6th.

*Minnesota*.—Moorhead, 10th; Saint Vincent, 23d.

*Missouri*.—Saint Louis, 7th.

*Nebraska*.—De Soto, 11th.

*New Hampshire*.—Nashua, 22d.

*New Jersey*.—Egg Harbor City, 11th; Atlantic City, 11th, 12th.

*New York*.—Ithaca, 13th, 20th.

*North Carolina*.—Kitty Hawk, 6th.

*Ohio*.—Cleveland, 13th; Napoleon, 15th.

*Rhode Island*.—Block Island, 11th, 21st.

*South Carolina*.—Spartanburg, 7th, 8th, 9th, 13th, 15th; Stateburg, 7th, 8th, 10th, 13th.

*Tennessee*.—Milan, 5th, 19th; Paris, 6th, 9th, 12th; Nashville, 7th, 10th; Austin and Chattanooga, 10th; Ashwood, 12th.

*Texas*.—Galveston and Rio Grande City, 9th; Brownsville, 10th; Cleburne and Palestine, 11th, 12th; Fort Elliott, 12th, 13th; Corsicana, 13th; San Antonio, 14th.

*Virginia*.—Cape Henry, 7th, 8th; Bird's Nest, 8th; Lynchburg, 9th, 11th, 13th; Variety Mills, 13th; Dale Enterprise, 21st.

The phases of the moon (Washington mean time) during June, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 1st, 20 h. 47.1

m.; first quarter, 8th, 14 h. 18.5 m.; full moon, 15th, 20 h. 30.6 m.; last quarter, 23d, 23 h. 26.6 m.; apogee, 20th, 23.8 h.; perigee, 5th, 5.7 h.

#### MIRAGE.

Webster, Dakota, 3d, 4th, 5th, 9th, 11th.

Duluth, Minnesota, 7th.

Port Angeles, Washington Territory, 13th.

Egg Harbor City, New Jersey, 20th.

#### MISCELLANEOUS PHENOMENA.

##### DROUGHT.

Key West, Florida: on the 6th 1.08 inches of rain fell, breaking the drought which had prevailed since May 1st.

Lamar, Missouri: the severe drought which had prevailed in this vicinity was broken on the 12th by a heavy rain which was of great value to crops. Farmers claim that the rain destroyed the chinch bug, which had previously existed in large numbers.

Owatonna, Steele county, Minnesota, 15th: crops were beginning to suffer serious injury from drought, wheat in many fields having turned yellow.

Geneva, New York, 18th: in the region between Seneca Lake and Lake Erie very little rain fell during the first half of the month. The ground was very dry and hard, not having enough moisture in places to germinate seed.

Gardiner, Kennebec county, Maine: on the 26th and 27th 1.10 inches of rain fell, greatly benefiting vegetation which had been suffering from drought, only 0.74 inch of rain having fallen from the 1st to the 26th.

Fort Madison, Lee county, Iowa, 30th: very little rain has fallen during the month; pastures and meadows are suffering from drought.

Cedar Rapids, Linn county, Iowa, 30th: the month has been exceptionally hot and dry, the monthly rainfall amounting to only 1.25 inches.

Des Moines, Iowa, 30th: crops in this vicinity were suffering from a drought as no heavy rains had fallen during the month. Wheat ripened before it was matured in consequence of the continued heat and lack of moisture.

Fargo, Cass county, Dakota, 30th: reports from nearly all parts of the territory indicate an extensive and severe drought.

Mandan, Morton county, Dakota, 30th: the continued dry weather had seriously injured the wheat crop.

Abilene, Texas, 30th: the dry weather still continues and is having a damaging effect on agricultural and stock-raising interests. Thousands of sheep have died from want of water and grass.

Geneseo, Henry county, Illinois, 30th: in this vicinity dry weather has prevailed throughout the month, ruining pasturage on the uplands.

Birmingham, Oakland county, Michigan, 30th: severe drought prevailed in this vicinity during the month.

Madison, Wisconsin: at the end of the month crops were much damaged from lack of moisture. A drought which had continued throughout the month had so injured crops that the yield will be much diminished. Winter wheat was prematurely ripened and corn was turning yellow.

##### EARTHQUAKES.

Port Antonio, Jamaica: on the 2d two shock of earthquake were felt, of about twenty seconds' duration. No damage was done.

San Francisco, California: on the 7th, at 4.13 p. m., a slight trembling motion of the earth was felt, followed by a sharp shock of about ten seconds' duration.

Oakland, California: on the 7th, at 1.31 p. m. (local time), a sharp shock of earthquake was felt. Windows were rattled and hanging objects were swayed back and forth in the direction of the vibrations, which were from west to east.

Antigua, West India Islands: sharp shocks of earthquake were felt on this island, and also at Saint Kitt's, on the 10th.

The following is from the Portland, Maine, "Daily Press," of June 12, 1886: